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JC951 U.S. PRO

11-08-00

REISSUE

JC913 U.S. PRO
09/707445
11/06/00

Practitioner's Docket No. A31-2047RE

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Date: _____

Assistant Commissioner for Patents
Washington, D.C. 20231

REISSUE APPLICATION TRANSMITTAL

Transmitted herewith is the application for reissue of U.S.

☒ Utility Patent ☐ Plant Patent ☐ Design Patent
No. 5,540,706 issued on July 30, 1996

Inventor(s):

Title:

Enclosed are the following:

1. Specification, claim(s) and drawing(s) (37 C.F.R. § 1.173)

- (a) ☒ 12 page(s) of specification
☒ 4 page(s) of claims
☒ 1 page(s) of abstract

NOTE: This must include the entire specification and claims of the patent, with the matter to be omitted by reissue enclosed in square brackets. Any additions made by the reissue must be underlined, so that the old and new specifications and claims may be readily compared. Claims should not be renumbered. The numbering of claims added by reissue should follow the number of the highest numbered patent claim. No new matter shall be introduced into the specification. (37 C.F.R. § 1.173).

CERTIFICATION UNDER 37 C.F.R. § 1.10*

(Express Mail label number is mandatory.)

(Express Mail certification is optional.)

I hereby certify that this Reissue Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date 11-6-00, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EF163919720US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Teresa Ragone

(type or print name of person mailing paper)

Teresa Ragone
Signature of person mailing paper

WARNING: Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

*WARNING: Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

(Reissue Application Transmittal [17-1]—page 1 of 6)

EXPRESS MAIL EF163919720US

Adjustment date: 04/23/2001 CCHAU1
11/09/2000 VYANG1 00000021 09707445
02 FC:209 -240.00 DP

04/23/2001 CCHAU1 00000025 09707445
01 FC:209 -80.00 DP

Repln. Ref: 04/23/2001 CCHAU1 0014163600
DRI:200090 Name/Number:09707445
FC:704 \$160.00 CR

(b) ☒ 5 sheet(s) of drawing (drawings amended)

☒ Formal

☐ Informal

NOTE: "Amendments which can be made in a reissue drawing, that is, changes from the drawing of the patent, are restricted." 37 C.F.R. § 1.174(b).

☒ No changes in the drawings, upon which the original patent was issued, are to be made. Therefore, in accordance with 37 C.F.R. § 1.174(a), please find attached, in the size required for original drawings:

☐ a copy of the printed drawings of the patent.

☐ a photoprint of the original drawings.

☒ A letter requesting transfer of the drawings from the original patent file to this reissue application is attached.

2. Declaration and power of attorney

☒ 6 pages of declaration and power of attorney

3. Preliminary amendment

(check, if applicable)

☒ Attached

4. Offer to surrender the original letters patent in accordance with 37 C.F.R. § 1.178 is attached.

☐ Offer to surrender is by the inventor

☐ along with assent of assignee.

☒ Offer to surrender is by the assignee of the entire interest (and the reissue application does not seek to enlarge the claims of the original patent).

5. Letters patent

☐ Original letters patent are attached.

☐ Declaration that original letters patent lost or inaccessible is attached.

☒ A copy of the original printed patent is attached.

NOTE: "The application may be accepted for examination in the absence of the original patent or the declaration but one or the other must be supplied before the case is allowed." 37 C.F.R. § 1.178.

NOTE: "Where the original patent grant is not submitted with the reissue application as filed, patentee should include a copy of the printed original patent. Presence of a copy of the original patent is useful for the calculation of the reissue filing fee and for the verification of other identifying data." M.P.E.P., § 1416, 7th ed.

NOTE: "If a reissue be refused, the original patent will be returned to applicant upon his request." 37 C.F.R. § 1.178.

(Reissue Application Transmittal [17-1]—page 2 of 6)

EXPRESS MAIL EF163919720US

6. Petition to proceed without assignee's assent

- ☐ Attached hereto is a "PETITION TO PROCEED WITH REISSUE APPLICATION WITHOUT ASSIGNEE'S ASSENT".

A. ☐ The fee payment is authorized in the attached:

- ☐ "REISSUE APPLICATION TRANSMITTAL" Form
☐ "COMPLETION OF FILING REQUIREMENTS — REISSUE APPLICATION" Form.

B. ☐ Payment is authorized below.

7. Information Disclosure Statement

- ☒ Attached
☒ Copies of the IDS citation(s) is/are attached.

8. Priority—35 U.S.C. § 119

- ☐ Priority of application Application No. 0 / _____, filed on _____, in _____ is claimed under 35 U.S.C. § 119.
Country

- ☐ The certified copy has been filed in prior application Application No. 0 / _____ filed on _____.

9. Basic Filing Fee Calculation (37 C.F.R. § 1.16(h), (i) and (j))

CLAIMS AS FILED			
Number Filed	Number Extra	Rate	Basic Fee (37 C.F.R. 1.16(h)) \$710.00
Total Claims (37 C.F.R. § 1.16(j))	9	— 20 (and also in excess of total claims in patent) 0X \$18.00	0
Independent Claims 37 C.F.R. § 1.16(i)	9 — 3	— (number of independent claims in patent) 6 X \$80.00	\$480.00
Filing fee Calculation			\$1,190.00

NOTE: Multiple dependent claims are treated as ordinary claims for fee purposes. 37 C.F.R. § 1.16(j).

(Reissue Application Transmittal [17-1]—page 3 of 6)

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10. Small Entity Status (applicable)

NOTE: A new statement is required for the reissue, even if one has been filed in the original patent. 37 C.F.R. § 1.27(a).

WARNING: "Small entity status must not be established when the person or persons signing the . . . statement can *unequivocally* make the required self-certification." M.P.E.P. § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).

- ☒ A statement that this filing is by a small entity is
☒ attached.

Filing Fee Calculation (50% of above) \$ 595.00

NOTE: If a statement is filed within 2 months of the date of timely payment of a fee, then the excess fee paid will be refunded on request. 37 C.F.R. § 1.28(a). Effective April 1, 1984.

11. Additional Fee Payments

- ☐ Payment is being made for "PETITION TO PROCEED WITH REISSUE APPLICATION WITHOUT ASSIGNEE"
(37 C.F.R. § 1.17(h)) \$130.00

12. Total Fees Due

Filing Fee	\$ <u>595.00</u>
Petition fee	\$ <u> </u>
Total Fees Due	\$ <u>595.00</u>

13. Method Of Payment of Fees

- ☒ Enclosed is a check in the amount of \$ 595.00.
☐ Charge Account No. in the amount of \$.
A duplicate of this request is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 C.F.R. § 1.22(b).

(Reissue Application Transmittal [17-1]—page 4 of 6)

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14. Authorization To Charge Additional Fees

WARNING: If no fees are to be paid on filing, the following items should not be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

- ☒ The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 20-0090 :

☒ 37 C.F.R. § 1.16(a), (f) or (g) (filing fees)

☒ 37 C.F.R. § 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

☒ 37 C.F.R. § 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

☒ 37 C.F.R. § 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a)).

☒ 37 C.F.R. § 1.17 (application processing fees)

NOTE: "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

NOTE: "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: See 37 C.F.R. § 1.28.

15. ☒ Additional Enclosures Assent By Assignee for Filing of Reissue Application

(Reissue Application Transmittal [17-1]—page 5 of 6)

EXPRESS MAIL EF163919720US

009074" 544/0/60

Reg. No.: 20,177

Tel. No.: (216) 621-2234

Customer No.:


SIGNATURE OF PRACTITIONER

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(Reissue Application Transmittal [17-1]—page 6 of 6)

Express Mail EF 163919720US

Practitioner's Docket No. A31-2047RE

PATENT

JC813 U.S. PTO
09/707445
11/06/83

REISSUE APPLICATION BY ASSIGNEE, OFFER TO SURRENDER
(37 C.F.R. § 1.178)

To the Assistant Commissioner for Patents:

The undersigned makes this statement as part of the accompanying reissue application for the reissue of letters patent number 5,540,706, for an improvement in SURGICAL INSTRUMENT,

granted on July 30, 1996, to Aust et al. and declares that

☐ he ☐ she ☒ it

is now owner by assignment of the entire interest in said original patent and hereby offers to surrender said letters patent.

CERTIFICATION UNDER 37 C.F.R. § 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this correspondence and the documents referred to as attached therein are being deposited with the United States Postal Service on this date 11-6-00, in an envelope as "Express Mail Post Office to Addressee," service under 37 C.F.R. § 1.10, Mailing Label Number EF163919720US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Teresa Ragone

(type or print name of person mailing paper)

Teresa Ragone

Signature of person mailing paper

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"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

(Reissue Application by Assignee, Offer to Surrender (37 C.F.R. § 1.178) [17-3]—page 1 of 2)

STATEMENT BY ASSIGNEE

Attached is a "STATEMENT UNDER 37 C.F.R. 3.73(b)," establishing the right of the assignee to take action in this reissue.

U.S. Patent Application Serial No. 08/008,670 filed January 25, 1993 and issued July 30, 1996 as U.S. Patent No. 5,540,706 was assigned to Endius Incorporated by an assignment recorded on December 3, 1999 at Reel/Frame 010437/0859

Date: 10/31/00

Gene P. DiPoto

Endius Incorporated

(type or print name of assignee)

Gene P. DiPoto

Signature

(type or print name of signatory and title if signing on behalf of an entity)

NOTE: This form may be used when the inventor is dead. It may also be used, with appropriate changes, when the reissue application does not seek to enlarge the claims of the original patent.

EXPRESS MAIL LABEL NO. EF163919720US

(Reissue Application by Assignee, Offer to Surrender (37 C.F.R. § 1.178) [17-3]—page 2 of 2)

Practitioner's Docket No. A31-2047RE

PATENT

ASSENT BY ASSIGNEE FOR FILING OF REISSUE APPLICATION

NOTE: The written assent of all assignees, if any, owning an undivided interest in the original patent must be included in the application for reissue. 37 C.F.R. 1.172(a).

This is part of the application for a reissue patent filed herewith based on the original patent identified as follows:

Gilbert M. Aust and Timothy E. Taylor
Name of Patentee

5,540,706
Patent Number

July 30, 1996
Date Patent Issued

SURGICAL INSTRUMENT
Title of Invention

I am an assignee owning

- ☒ an undivided interest to the above original patent.
☐ a _____% (per cent) interest in the above original patent.

I assent to the accompanying application for reissue.

Attached is a "Statement under 37 C.F.R. § 3.73(b) — Establishing Right of Assignee to Take Action."

Endius Incorporated
Name of assignee

Gene P. DiPoto
Signature of person signing for assignee

Date: 10/31/00

Gene P. DiPoto, Vice President
(type or print name and title of person signing for assignee)

EXPRESS MAIL LABEL NO. EF163919720US

Assent by Assignee for Filing of Reissue Application [17-8]

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SURGICAL INSTRUMENT

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved arthroscopic/endoscopic surgical instrument, and more specifically, to an arthroscopic/endoscopic surgical instrument which may be used to remove tissue from a joint or other body space.

Surgical instruments which may be used to remove tissue or perform other operations on tissue are disclosed in U.S. Pat. Nos. 4,499,899; 4,517,977; 4,649,919; and 4,834,729. The surgical instruments disclosed in these patents have stem sections which extend outwardly from a handle. A cutting tool or other device is disposed at the outer end of the stem section. The stem section is rigid. Therefore, the orientation of the cutting tool can not be changed relative to the stem section.

SUMMARY OF THE INVENTION

The present invention relates to a surgical instrument which is particularly well adapted for arthroscopic and/or endoscopic surgery. The surgical instrument has a stem section which is attached to a handle. A suitable instrument, such as a cutting tool, is connected with an outer end portion of the stem section by an articulated section. An actuator is provided to bend the articulated section to change the orientation of the instrument relative to the stem section and body tissue.

In one embodiment of the invention, a pair of flexible elongated elements, such as wires, are provided to bend the articulated section in opposite directions from an initial position. In this embodiment of the invention, the articulated section may be constructed so as to freely flex in a direction transverse to the direction in which the articulated section is bent by the elongated elements. In another embodiment of the invention, a plurality of elongated elements, such as wires, are provided to flex or bend the articulated section in any one of four directions.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects and features of the present invention will become more apparent upon a consideration of the following description taken in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic illustration of a surgical instrument constructed in accordance with the present invention;

FIG. 2 is a schematic sectional view, taken generally along the line 2—2 of FIG. 1, illustrating the manner in which a known handle is connected with a tubular stem section of the surgical instrument;

FIG. 3 is an enlarged schematic sectional view depicting the manner in which an actuator for bending an articulated section of the surgical instrument is mounted on the stem section and the manner in which a drive shaft is connected with a tubular drive element which extends through the stem section;

FIG. 4 is an enlarged schematic side elevational view depicting the construction of an articulated section of the stem section;

FIG. 5 is a schematic plan view, taken generally along the line 5—5 of FIG. 4, further illustrating the construction of the articulated section of the stem section;

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FIG. 6 is a highly schematicized illustration depicting the manner in which a pair of wires are connected with an actuator assembly which tensions one of the wires to bend the articulated section of the stem section;

FIG. 7 is an enlarged schematic side elevational view, generally similar to FIG. 4, illustrating the manner in which the articulated section is flexed by the actuator assembly of FIG. 6;

FIG. 8 (on sheet 4 of the drawings) is a highly schematicized illustration depicting deflection of the articulated section in either one of two directions by the actuator assembly of FIG. 6 and depicting the manner in which the articulated section is free to move in either one of two transverse directions; and

FIG. 9 (on sheet 2 of the drawings) is a fragmentary schematic illustration depicting an embodiment of the invention in which the articulated section can be flexed in any one of four directions by an actuator system.

DESCRIPTION OF SPECIFIC PREFERRED EMBODIMENTS OF THE INVENTION

General Description

A surgical instrument 20, constructed in accordance with the present invention, is illustrated in FIG. 1 and may be used during the performance of arthroscopic and/or endoscopic surgery. A control apparatus 22 is connected with the surgical instrument 20 through a cord system 24. The surgical instrument 20 includes a handle 28 of known construction, which is connected with a tubular stem section 30. A known instrument 32 is connected with a rigid portion 33 of the stem section by an articulated section 34 constructed in accordance with the present invention.

In accordance with one of the features of the present invention, an actuator assembly 38 is manually operable to bend the articulated section 34 to move the instrument 32 between any one of many positions relative to the rigid portion 33 of the stem section 30. The actuator assembly 38 can be operated to bend the articulated section 34 from a straight or initial condition shown in FIGS. 4 and 5 to any one of a plurality of bent conditions, some of which have been indicated schematically in FIG. 7. Thus, the actuator assembly 38 can be operated to bend the articulated section 34 upwardly from the straight or initial orientation (shown in solid lines in FIGS. 4, 5 and 7) through a plurality of positions, indicated in dashed lines and dash-dot lines to a fully flexed position indicated in dash-dot-dot lines in FIG. 7.

Of course, operation of the actuator assembly 38 could be interrupted with the instrument 32 in any one of the positions illustrated in FIG. 7 or in positions intermediate the positions shown in FIG. 7. In addition, the actuator assembly 38 can be operated to deflect the articulated section 34 downwardly (as viewed in FIGS. 4 and 7) to any one of a plurality of positions. When the actuator assembly 38 has been operated to bend the articulated section 34 downward to a fully deflected position, the instrument 32 will extend straight downwardly in much the same manner as in which the instrument has been shown extending straight upwardly in dash-dot-dot lines in FIG. 7. Thus, the actuator assembly 38 is operable to bend the articulated section 34 and to move the instrument 32 relative to the rigid portion 33 of the stem section 30 in such a manner as to change the orientation of the instrument 32 through 90° to either a straight upward orientation (as shown in dash-dot-dot lines in FIG. 7) or to a straight downward orientation.

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In accordance with another feature of the embodiment of the invention illustrated in FIGS. 1-8, the articulated section 34 can be freely bent or deflected sidewardly, that is either up or down as viewed in FIG. 5 or into and out of the sheet as viewed in FIGS. 4 and 7. Although the actuator assembly 38 is operable to positively deflect or bend the articulated section either up or down as viewed in FIG. 4, the articulated section 34 is allowed to float or bend sidewardly under the influence of forces applied to the articulated section.

The actuator assembly 38 can be operated to change the orientation of the instrument 32 relative to the rigid portion 33 of the stem section 30 and body tissue during an operation. The actuator assembly 38 can be operated to positively change the orientation of the instrument 32 through a range of 180°, that is through 90° upwardly (as viewed in FIGS. 4 and 7) from the straight initial orientation and through 90° downwardly (as viewed in FIGS. 4 and 7) from the straight initial orientation. In addition, the articulated section 34 can be deflected or bent under the influence of forces applied to the instrument 32, through 90° to either side of the straight initial orientation shown in FIGS. 4 and 5.

It is believed that the surgical instrument 20 will be particularly advantageous for removing tissue from between vertebra in the human spinal column during an operation. Thus, the instrument 32, articulated section 34 and part of the rigid portion 33 of the stem section 30 can be inserted through a very small opening in the skin adjacent to the spinal column of a patient. As this is done, the articulated section 34 is straight in the initial orientation shown in FIGS. 1, 4 and 5.

After the stem section 30 has been partially inserted through an opening in the skin adjacent to the spinal column, the actuator assembly 38 is operated to bend the articulated section 34 and move the surgical instrument 32 transversely to a longitudinal central axis of the rigid portion 33 of the stem section 30. This enables the instrument 30 to be moved to a desired position to engage tissue located between adjacent vertebra. As the instrument 32 is being moved by operation of the actuator assembly 38, the articulated section 34 can also be deflected sideways under the influence of forces applied against the instrument 32. Of course, the surgical instrument 20 can be used during the performance of many different types of arthroscopic and/or endoscopic operations.

During use of the surgical instrument 20, it is contemplated that it will be desirable to convey tissue removed from between vertebra or other locations away from the instrument 32. Accordingly, a suction pump (not shown) is connected with the handle 28 at a connection 44. Suction is conducted through a central conduit or passage 45 (FIGS. 3 and 4) in the stem section 30 to the instrument 32. The suction draws or pulls tissue from the area immediately adjacent to the instrument 32 back through the stem section 30 to the connection 44 and suction conduit.

In addition, water or other fluid can be utilized to irrigate the area where tissue is removed by the instrument 32. Thus, a source of water or other irrigation fluid is connected with the handle 28 at a connection indicated at 46 in FIG. 1. The irrigation fluid is conducted through the handle 28 and the central conduit 45 in the stem section 30 to the instrument 32. Irrigating fluid, along with the removed tissue, is then withdrawn from the area around the surgical instrument 32.

Articulated Section

The articulated section 34 includes a plurality of relatively movable sections 50, 52, 54 and 56 (FIGS. 4 and 5). The sections 50, 52, 54 and 56 are interconnected for pivotal

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movement about perpendicular axes. Thus, the section 50 is pivotal relative to the section 52 about a vertical axis indicated at 60 in FIG. 4. The section 50 is connected with the section 52 at pivot connections 62 and 64. Similarly, the section 54 is pivotal relative to the section 56 about a vertical axis indicated at 66 in FIG. 4. The section 54 is connected with the section 56 at pivot connections 68 and 70.

The section 52 is pivotal relative to the section 54 about a horizontal axis indicated at 72 in FIG. 5. The section 52 is connected with the section 54 at pivot connections 74 and 76. Similarly, the section 56 is pivotal relative to an end portion 78 of the rigid stem section 33 about a horizontal axis indicated at 82 in FIG. 5. The section 56 is connected with the rigid portion 33 of the stem section 30 at pivot connections 84 and 86.

The instrument 32 is pivotal relative to the section 50 about a horizontal axis indicated at 92 in FIG. 5. The instrument 32 is connected with the section 50 at pivot connections 94 and 96.

The axes 60 and 66 (FIG. 4) extend parallel to each other and perpendicular to a longitudinal central axis of the stem section 30. Similarly, the axes 72, 82 and 92 (FIG. 5) extend parallel to each other and perpendicular to a longitudinal central axis of the stem section 30. The axes 60 and 66 extend perpendicular to the axes 72, 82 and 92. The axes 60, 66, 72, 82 and 92 all intersect the central axis of the stem section 30.

Initial operation of the actuator assembly 38 in one direction pivots the instrument 32 upwardly (as shown in FIG. 7) from the initial position shown in solid lines to the deflected position shown in dashed lines. Movement of the instrument 32 from the initial position shown in solid lines to the deflected position shown in dashed lines, is accomplished by pivotal movement of the instrument about the axis 92 at the pivot connections 94 and 96 (FIG. 5).

Continued operation of the actuator assembly 38 pivots the sections 50 and 52 together while the instrument 32 is maintained in a deflected position. Thus, the sections 50 and 52 pivot upwardly from the initial position shown in solid lines in FIG. 7 to the position shown in dash-dot lines in FIG. 7. As this occurs, the sections 50 and 52 pivot about the axis 72 (FIG. 5) at the pivot connections 74 and 76. During this movement, the orientation of the instrument 32 relative to the section 50 remains constant.

Continued operation of the actuator assembly 38 pivots the sections 54 and 56 upwardly (as viewed in FIG. 7) from the initial position shown in solid lines to the position shown in dash-dot-dot lines. The instrument 32 and sections 50 and 52 are maintained in the same orientation relative to each other during this pivotal movement of the sections 54 and 56. Thus, continued operation of the actuator assembly 38 pivots the sections 54 and 56 about the axis 82 (FIG. 5) at the pivot connections 84 and 86.

During deflection of the articulated section 34 about the axes 72, 82 and 92 (FIG. 5) by operation of the actuator assembly 38, the articulated section 34 is also free to deflect sideways under the influence of forces applied against the articulated section. Thus, the section 50 and the instrument 32 are pivotal sideways relative to the section 52 about the axis indicated at 60 in FIG. 4. The section 50 is pivotal sideways at the connections 62 and 64. The sections 50, 52 and 54 are pivotal sideways relative to the section 56 about the axis indicated at 66 in FIG. 4. The section 54 is pivotal sideways at the connections 68 and 70.

Actuator Assembly

The actuator assembly 38 includes a pair of flexible wires 102 and 104 (FIGS. 6 and 7) which are connected with the

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instrument 32 through the tubular stem section 30. The wire 102 is connected with the upper (as viewed in FIG. 7) portion of the instrument 32 while the wire 104 is connected with the lower portion of the instrument 32. The wires 102 and 104 are offset from the pivot connections 94 and 96 (FIGS. 5 and 7).

Tension in the upper wire 102 (as viewed in FIG. 7) is effective to pivot the instrument 32 in a clockwise direction about the pivot connections 94 and 96. Similarly, tension in the lower wire 104 is effective to pivot the instrument 32 in a counterclockwise direction (as viewed in FIG. 7) about the pivot connections 94 and 96.

When the actuator assembly 38 (FIG. 6) is operated in one direction, the wire 102 shortens slightly and the wire 104 is lengthened to pull the instrument 32 from the initial position shown in solid lines to the position shown in dashed lines in FIG. 7. Once the instrument 32 reaches the position shown in dashed lines in FIG. 7, further shortening of the wire 102 and lengthening of the wire 104 by operation of the actuator assembly 38 pulls the sections 50 and 52 in a clockwise direction (as viewed in FIG. 7) from the initial position shown in solid lines to the position shown in dash-dot lines in FIG. 7. As this occurs, the section 52 pivots about the axis 72 at the connections 74 and 76.

Continued operation of the actuator assembly 38 continues to shorten the wire 102 and lengthen the wire 104. This results in the sections 54 and 56 being pulled in a clockwise direction (as viewed in FIG. 7) from the initial position shown in solid lines to the position shown in dash-dot-dot lines. As this occurs, the sections 54 and 56 pivot about the axis 82 (FIG. 5) at the connections 84 and 86.

Operation of the actuator assembly 38 in the opposite direction is effective to shorten the wire 104 and lengthen the wire 102. As the actuator assembly is operated in the opposite direction to shorten the wire 104, the instrument 32 is pivoted downwardly or in a counterclockwise direction (as viewed in FIG. 7) about the axis 92 (FIG. 5) at the connections 94 and 96.

Continued operation of the actuator assembly 38 results in further lengthening of the wire 102 and shortening of the wire 104. This results in the sections 50 and 52 being pivoted downwardly or in a counterclockwise direction (as viewed in FIG. 7) about the axis 72 at the pivot connections 74 and 76. Still further operation of the actuator assembly 38 to lengthen the wire 102 and shorten the wire 104 results in the sections 54 and 56 pivoting downwardly or in a counterclockwise direction (as viewed in FIG. 7) about the axis 82 at the connections 84 and 86 (FIG. 5). Thus, the articulated sections 34 can be deflected or bent either upwardly, in the manner shown in FIG. 7, or downwardly depending upon the direction of operation of the actuator assembly 38.

The actuator assembly 38 has been shown schematically in FIG. 6. The actuator assembly 38 includes a pair of pulleys or drums 108 and 110 to which end portions of the wires 102 and 104 are connected. The wires 102 and 104 are wound in opposite directions about the drums 108 and 110. The drums 108 and 110 rotate together about a common axis. Therefore, when one of the wires 102 or 104 is wound onto a drum 108 or 110, the other wire is unwound from the other drum.

Upon pivotal movement of a handle 114, a gear train 116 is actuated. The gear train 116 has been illustrated schematically in FIG. 3. The gear train 116 includes a gear 118 which is fixedly connected with the handle 114 and a gear 120 which is fixedly connected with the pulleys or drums 108 and 110 (FIG. 6).

Upon pivotal movement of the lever 114 toward the left or in a counterclockwise direction as viewed in FIG. 3, the

gear 120° and drums 108 and 110 (FIG. 6) are rotated in a clockwise direction. This results in the wire 102 being wound onto the drum 108 and the wire 104 being unwound from the drum 110. As was previously explained, shortening or winding up of the wire 102 results in the instrument 32 being pivoted upwardly or in a clockwise direction as viewed in FIG. 7.

Pivotal movement of the handle 114 in a clockwise direction (as viewed in FIG. 3) rotates the gear 120 and drums 1108 and 110 (FIG. 6) in a counterclockwise direction. This results in the wire 104 being wound onto the drum 110 as the wire 102 is wound off of the drum 108. Shortening of the wire 104 and corresponding lengthening of the wire 102 results in the articulated section 34 being pivoted downwardly or in a counterclockwise direction as viewed in FIG. 7 in the manner previously explained.

It should be understood that although one specific preferred embodiment of the actuator assembly 38 has been illustrated schematically and described herein, it is contemplated that the actuator assembly 38 could have a somewhat different construction if desired. Thus, many different types of mechanisms could be provided lengthening one of the wires 102 or 104 while simultaneously shortening one of the wires.

Regardless of the type of actuator assembly 38 which is utilized to deflect or bend the articulated section 34, the actuator assembly is operable to apply force to the articulated section to deflect the articulated section from a straight initial configuration to an upwardly or downwardly (as viewed in FIG. 7) bent configuration. Thus, upon operation of the actuator assembly 38, the articulated section 34 can be deflected in the manner shown in dashed, dash-dot and dash-dot-dot lines in FIG. 7. This will result in the instrument 32 being moved upwardly from a position in which it is aligned with a horizontal Z axis (FIG. 8) to a position in which it is aligned with a vertical Y axis. The Z axis is coincident with a longitudinal central axis of the rigid portion 33 of the stem section 30.

The actuator assembly 38 can also be operated to bend or deflect the articulated section 34 to move the instrument 32 downwardly from the Z axis into alignment with the Y axis in the manner shown in dashed lines in FIG. 8. At this time, the instrument 32 extends downwardly from and perpendicular to the X and Z axes.

The actuator assembly 38 is operable to deflect the articulated section 34 to move the instrument 32 in either one of two directions, that is upwardly or downwardly as viewed in FIGS. 7 and 8. However, the articulated section 34 is deflectable to enable the instrument to be moved sidewardly. Thus, the articulated section 34 can be moved, under the influence of external or sideways forces applied against the instrument 32, to move the instrument from the initial position toward the left into alignment with the X axis as shown in dash-dot lines in FIG. 8. Similarly, the instrument 32 can be deflected toward the right (as viewed in FIG. 8) into alignment with the X axis in the manner shown in dash-dot-dot lines. By a combination of operation of the

actuator assembly 38 and sideward deflection of the instrument 32, the articulated section 34 can be deflected in such a manner as to move the instrument 32 into almost any position within a hemisphere having a central polar axis which is coincident with the Z axis (FIG. 8).

Instrument

In the embodiment of the invention illustrated in FIGS. 4 and 5, the instrument 32 includes a rotatable cutter 124 (FIG. 5). The cutter 124 is connected with a drive shaft 126 (FIG. 3) of a motor in the handle 28 (FIG. 1). During operation of the motor, the cutter 124 is rotated to cut tissue. Although the cutter 124 may have many different constructions, it is contemplated that the cutter may be constructed in a manner similar to that disclosed in U.S. Pat. No. 4,598,710.

Other known surgical instruments may be substituted for the cutter 124. Thus, a generally spherical rotatable burr or router may be used to abrade tissue. If desired, a probe or a basket biter having known constructions could be substituted for the cutter 124. Of course, the particular type of instrument 32 which is connected with the outer end portion of the articulated section 34 will depend upon the surgical operation to be performed.

The cutter 124 is rotatable about the longitudinal central axis of the stem section 30 to cut tissue. A rigid tubular metal drive shaft 128 extends axially from the drive shaft 126 through the rigid portion 33 of the stem section 30 to the articulated section 34 (FIGS. 3, 4 and 5). Since the articulated section 34 is capable of being deflected in any desired direction, the rigid drive shaft 128 stops short of the articulated section 34 and is secured to a flexible tubular polymeric drive shaft 130 (FIG. 7). The flexible drive shaft 130 extends through the articulated section 34 and is connected to the rotatable cutter 24.

The rigid drive shaft 128 is connected with the drive shaft 126 (FIG. 3) of a suitable electric motor in the handle 28 and is rotated about its longitudinal central axis by operation of the motor. The rigid drive shaft 128 is rotatably supported within a rigid tubular metal housing 134 by a plurality of spaced apart bearing or spacer blocks 136 (FIGS. 3, 4 and 7). The bearing blocks 136 are disposed at spaced apart locations about the circumference of the drive shaft 128. The bearing blocks 136 are fixedly connected with the stationary housing 134 and support the drive shaft 128 for rotation relative to the housing.

The wires 102 and 104 (FIG. 7) extend through space between adjacent bearing blocks 136. It should be noted that suitable guides (not shown) are provided on the inside of the housing 134 to guide the wires 102 and 104 between the articulated section 34 and the actuator assembly 38. Although many different types of known guides could be used, it is contemplated that it may be preferred to utilize guides having holes through which the wires 102 and 104 extend and which are formed of suitable polymeric material to minimize friction against the surface of the wires 102 and 104.

The wires 102 and 104 are disposed radially outwardly of the rigid metal drive shaft 128 and the flexible drive shaft 130. This allows the outer end portions of the wires 102 and 104 to be fixedly secured to diametrically opposite portions of the instrument 32 in the manner indicated schematically at 142 and 144 in FIG. 7.

Fluid for irrigating an area adjacent to the cutter 124 is conducted through the conduit 45 formed in the tubular rigid drive shaft 128 and the tubular flexible drive shaft 130 (FIGS. 3, 4 and 5) to the cutter 124. The suction draws the irrigating fluid and any loose tissue away from the cutter 124.

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It is contemplated that a thin flexible polymeric sheet may be provided around the articulated section 34. However, the sheet has been omitted in the drawings for purposes of clarity of illustration.

Second Embodiment

In the embodiment of the invention illustrated in FIGS. 1-8, the actuator assembly 38 is operable to bend the articulated section either upwardly or downwardly from the Z axis in the plane of the Y axis (FIG. 8). However, the articulated section 34 is constructed so that it is deflectable or bendable by forces applied to the instrument 32 or the articulated section 34 to deflect the instrument 32 to either side of the plane of the X and Z axes, in the manner indicated schematically in FIG. 8.

It is contemplated that it may be desirable to have the actuator assembly 38 constructed in such a manner as to be operable to bend the articulated section 34 in any desired direction. An embodiment of the invention having an actuator assembly constructed so as to deflect the articulated section 34 in any desired direction is illustrated in FIG. 9. Since the embodiment of the invention illustrated in FIG. 9 is generally similar to the embodiment of the invention illustrated in FIGS. 1-8, similar numerals will be utilized to designate similar components, the suffix letter "a" being associated with the numerals of FIG. 9 in order to avoid confusion.

In the embodiment of the invention illustrated in FIG. 9, a surgical instrument 20a has a handle 28a which is connected with an instrument 32a by a stem section 30a. The stem section 30a includes a rigid section 33a and an articulated section 34a.

In accordance with a feature of this embodiment of the invention, an actuator 38a is provided to move the instrument 32a in a plane containing the Z and Y axes (FIG. 8). A second actuator assembly 152 is provided to move the instrument 32a in the plane containing the X and Z axes (FIG. 8). Thus, the two actuator assemblies 38a and 152 function as an actuator system which enables a surgeon to move the instrument 32a anywhere within a hemisphere by operating the actuator assemblies.

The actuator assembly 38a is connected with the instrument 32a by wires 102a and 104a. The actuator assembly 152 is connected with the instrument 32a by wires 156 and 158. The wires 102a, 104a, 156 and 158 are connected with the instrument 32a at locations which are offset from each by 90° about the circumference of the instrument 32a. The wires 102a and 104a are connected with the instrument 32a at locations which are diametrically opposite from each other. The wires 156 and 158 are connected with the instrument 32a at locations which are located diametrically opposite from each other and on a diameter which extends perpendicular to a diameter extending through the connections of the wires 102a and 104a to the instrument 32a. The combination of the four wires 102a, 104a, 156 and 158 and the actuator assemblies 38a and 152 enable the instrument 32a to be pivoted in any desired direction relative to the rigid stem 33a.

In the embodiment of the invention illustrated in FIG. 9, the actuator assembly 152 has the same construction as the actuator assembly 38a. However, it is contemplated that it may be desirable to combine the functions of the actuator assemblies 152 and 38a into a single actuator assembly which would operate all four wires 102a, 104a, 156 and 158. However, it should be understood that the two actuator assemblies 38a and 152 cooperate and function together in such a manner so as to enable a surgeon to move the instrument 32a in any desired direction from the initial position shown in FIG. 9.

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Conclusion

The present invention relates to a surgical instrument 20 which is particularly well adapted for arthroscopic and/or endoscopic surgery. The surgical instrument 20 has a stem section 30 which is attached to a handle 28. A suitable instrument 32, such as a cutting tool, is connected with an outer end portion of the stem section 30 by an articulated section 34. An actuator 38 is provided to bend the articulated section 34 to change the orientation of the instrument 32 relative to the stem section 30 and body tissue.

In one embodiment of the invention, a pair of flexible elongated elements 102 and 104, such as wires, are provided to bend the articulated section 34 in opposite directions from an initial position. In this embodiment of the invention, the articulated section 34 may be constructed so as to freely flex in a direction transverse to the direction in which the articulated section is bent by the elongated elements 102 and 104. In another embodiment of the invention (FIG. 9), a plurality of elongated elements 102a, 104a, 156 and 158, such as wires, are provided to flex or bend the articulated section 34a in any one of four directions.

Having described the invention, the following is claimed:

1. A surgical instrument comprising a stem section extending from a handle, a cutting tool, said cutting tool including a rotatable cutter, a hollow articulated section connected with said cutting tool and said stem section, a rotatable drive shaft connected with said cutter and disposed in and extending axially through said stem section and said articulated section, said drive shaft having a flexible portion disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible portion of said drive shaft to change the orientation of said cutter relative to tissue from a first orientation to a second orientation, said actuator means including first and second elongated elements which extend through said stem section and articulated section and are connected with said cutting tool, said elongated elements being disposed between an outer side surface of said flexible portion of said drive shaft and an inner side of said articulated section, said actuator means including means for pulling on one of said elongated elements to bend said articulated section and said flexible portion of said drive shaft to change the orientation of said cutter from the first orientation to the second orientation, said drive shaft being rotatable relative to said articulated section to rotate said cutter when said cutter is in the first orientation and when said cutter is in the second orientation;

said surgical instrument further including passage means extending axially through said drive shaft for conducting tissue from a location adjacent to said cutter through said articulated section and said stem section toward the handle.

2. A surgical instrument comprising a stem section extending from a handle, a cutting tool, said cutting tool including a rotatable cutter, a hollow articulated section connected with said cutting tool and said stem section, a rotatable drive shaft connected with said cutter and disposed in and extending axially through said stem section and said articulated section, said drive shaft having a flexible portion disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible portion of said drive shaft to change the orientation of said cutter relative to tissue from a first orientation to a second orientation, said actuator means including first and second elongated elements which extend through said stem section and articulated section and are connected with said cutting tool, said elongated elements

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being disposed between an outer side surface of said flexible portion of said drive shaft and an inner side of said articulated section, said actuator means including means for pulling on one of said elongated elements to bend said articulated section and said flexible portion of said drive shaft to change the orientation of said cutter from the first orientation to the second orientation, said drive shaft being rotatable relative to said articulated section to rotate said cutter when said cutter is in the first orientation and when said cutter is in the second orientation;

said surgical instrument further including passage means extending through said drive shaft for conducting irrigating fluid through said drive shaft from said handle to said cutter.

3. A surgical instrument comprising a hollow rigid stem section extending from a handle, a cutting tool, said cutting tool including a rotatable cutter, a hollow articulated section connected with said cutting tool and said stem section, a rotatable drive shaft connected with said cutter and disposed in and extending axially through said stem section and said articulated section, said drive shaft including a rigid section disposed in said stem section and a flexible section disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible section of said drive shaft to change the orientation of said cutter relative to tissue from a first orientation to a second orientation, said drive shaft being rotatable relative to said articulated section when said cutter is in the first orientation and when said cutter is in the second orientation;

said surgical instrument further including passage means extending axially through said drive shaft for conducting tissue from a location adjacent to said cutter through said articulated section and said stem section toward the handle.

4. A surgical instrument comprising a hollow rigid stem section extending from a handle, a cutting tool, said cutting tool including a rotatable cutter a hollow articulated section connected with said cutting tool and said stem section, a rotatable drive shaft connected with said cutter and disposed in and extending axially through said stem section and said articulated section, said drive shaft including a rigid section disposed in said stem section and a flexible section disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible section of said drive shaft to change the orientation of said cutter relative to tissue from a first orientation to a second orientation, said drive shaft being rotatable relative to said articulated section when said cutter is in the first orientation and when said cutter is in the second orientation;

wherein said actuator means includes first and second elongated elements which extend through said stem section and articulated section and are connected with said cutting tool, said elongated elements being disposed between an outer side surface of said flexible section of said drive shaft and an inner side of said articulated section, said actuator means including means for pulling on said first elongated element to bend said articulated section and the flexible section of the drive shaft in a first direction, said actuator means including means for pulling on said second elongated element to bend said articulated section and said flexible section of said drive shaft in a second direction opposite to said first direction.

5. A surgical instrument comprising a hollow rigid stem section extending from a handle, a cutting tool, said cutting tool including a rotatable cutter, a hollow articulated section connected with said cutting tool and said stem section, a

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rotatable drive shaft connected with said cutter and disposed in and extending axially through said stem section and said articulated section, said drive shaft including a rigid section disposed in said stem section and a flexible section disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible section of said drive shaft to change the orientation of said cutter relative to tissue from a first orientation to a second orientation, said drive shaft being rotatable relative to said articulated section when said cutter is in the first orientation and when said cutter is in the second orientation;

6. A surgical instrument comprising a stem section extending from a handle, a movable member, a hollow articulated section connected with said movable member and said stem section, a drive shaft connected with said movable member and disposed in and extending axially through said stem section and said articulated section, said drive shaft having a flexible portion disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible portion of said drive shaft to change the orientation of said movable member relative to tissue from a first orientation to a second orientation, said actuator means including first and second elongated elements which extend through said stem section and articulated section and are connected with said movable member, said actuator means including means for pulling on one of said elongated elements to bend said articulated section and said flexible portion of said drive shaft to change the orientation of said movable member from the first orientation to the second orientation, said drive shaft being movable relative to said articulated section to move said movable member when said movable member is in the first orientation and when said movable member is in the second orientation;

7. A surgical instrument comprising a stem section extending from a handle, a movable member, a hollow articulated section connected with said movable member and said stem section, a drive shaft connected with said movable member and disposed in and extending axially through said stem section and said articulated section, said drive shaft having a flexible portion disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible portion of said drive shaft to change the orientation of said movable member relative to tissue from a first orientation to a second orientation, said actuator means including first and second elongated elements which extend through said stem section and articulated section and are connected with said movable member, said actuator means including means for pulling on one of said elongated elements to bend said articulated section and said flexible portion of said drive shaft to change the orientation of said movable member from the first orientation to the second orientation, said drive shaft being movable relative to said articulated section to move said

movable member when said movable member is in the first orientation and when said movable member is in the second orientation:

said surgical instrument further including passage means extending through said drive shaft for conducting irrigating fluid through said drive shaft from said handle to said movable member.

[8. A surgical instrument comprising a handle, a stem section extending from said handle, means for acting on tissue including a movable member, a hollow articulated section connected with said movable member and said stem section, means connected with said movable member for moving said movable member relative to said articulated section, said means being disposed in and extending axially through said stem section and said articulated section, said means having a flexible portion disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible portion of said means for moving said movable member to change the orientation of said movable member relative to tissue from a first orientation to a second orientation. said actuator means including at least one elongate element which extends through said stem section and articulated section and is connected with said movable member, said means for moving said movable member being movable relative to said articulated section to move said movable member relative to said articulated section when said movable member is in the first orientation and when said movable member is in the second orientation;

said surgical instrument further including passage means extending axially through said means for moving said movable member for conducting tissue from a location adjacent to said movable member through said articulated section and said stem section toward said handle.

9. A surgical instrument comprising a handle, a stem section extending from said handle, means for acting on tissue including a movable member, a hollow articulated section connected with said movable member and said stem section, means connected with said movable member for moving said movable member relative to said articulated section, said means being disposed in and extending axially through said stem section and said articulated section, said means having a flexible portion disposed in said articulated section, and actuator means connected with said handle for bending said articulated section and said flexible portion of said means for moving said movable member to change the orientation of said movable member relative to tissue from a first orientation to a second orientation, said actuator means including at least one elongate element which extends through said stem section and articulated section and is connected with said movable member, said means for moving said movable member being movable relative to said articulated section to move said movable member relative to said articulated section when said movable member is in the first orientation and when said movable member is in the second orientation;

said surgical instrument further including passage means extending through said means for moving said movable member for conducting irrigating fluid from said handle to said movable member.

10. A surgical instrument comprising:

a handle;

a stem section extending from said
handle;

means for acting on tissue including a
movable member;

a hollow articulated section connected
to said movable member and said stem section;

means connected to a portion of said
movable member for moving said portion relative to
said articulated section, said means being disposed
in and extending axially through said stem section
and said articulated section, said means having a
flexible portion disposed in said articulated
section; and

actuator means connected to said handle
for bending said articulated section and said
flexible portion of said means for moving said
portion of said movable member to change the
orientation of said movable member relative to
tissue from a first orientation to a second
orientation, said actuator means including at least
one elongated element which extends through said
stem section and said articulated section and is
connected to said movable member;

said means for moving said portion of
said movable member being movable relative to said

articulated section when said movable member is in the first orientation and when said movable member is in the second orientation;

said surgical instrument further including passage means for conducting tissue from a location adjacent to said movable member to said handle, said passage means extending axially from said movable member through said articulated section and said stem section to said handle, said passage means extending through said means for moving said portion of said movable member.

11. A surgical instrument comprising:

a handle;

a stem section extending from said handle;

means for acting on tissue including a movable member;

a hollow articulated section connected to said movable member and said stem section;

means connected to a portion of said movable member for moving said portion relative to said articulated section, said means being disposed in and extending axially through said stem section and said articulated section, said means having a flexible portion disposed in said articulated section; and

actuator means connected to said handle
for bending said articulated section and said
flexible portion of said means for moving said
portion of said movable member to change the
orientation of said movable member relative to
tissue from a first orientation to a second
orientation, said actuator means including at least
one elongated element which extends through said
stem section and said articulated section and is
connected to said movable member;

said means for moving said portion of
said movable member being movable relative to said
articulated section to move said movable member
relative to said articulated section when said
movable member is in the first orientation and when
said movable member is in the second orientation;

said surgical instrument further
including passage means for conducting irrigating
fluid from said handle to said movable member, said
passage means extending axially from said handle
through said articulated section and said stem
section to said movable member, said passage means
extending through said means for moving said
portion of said movable member.

ABSTRACT

A surgical instrument includes a tubular stem section which extends from a handle. A tubular articulated section connects a surgical instrument with the stem section. An actuator assembly is connected with the handle and is operable to bend the articulated section to change the orientation of an instrument on an outer end portion of the articulated section relative to body tissue. The instrument on the outer end of the articulated section may be a rotatable cutting tool which is driven by a tubular drive element having a flexible section which extends through the articulated section. The articulated section is bent or flexed by a plurality of flexible elongated elements (wires). In one embodiment of the invention, a pair of elongated elements are provided to flex the articulated section in opposite directions. In another embodiment of the invention, four flexible elongated elements are provided to flex the articulated section in any one of four directions.

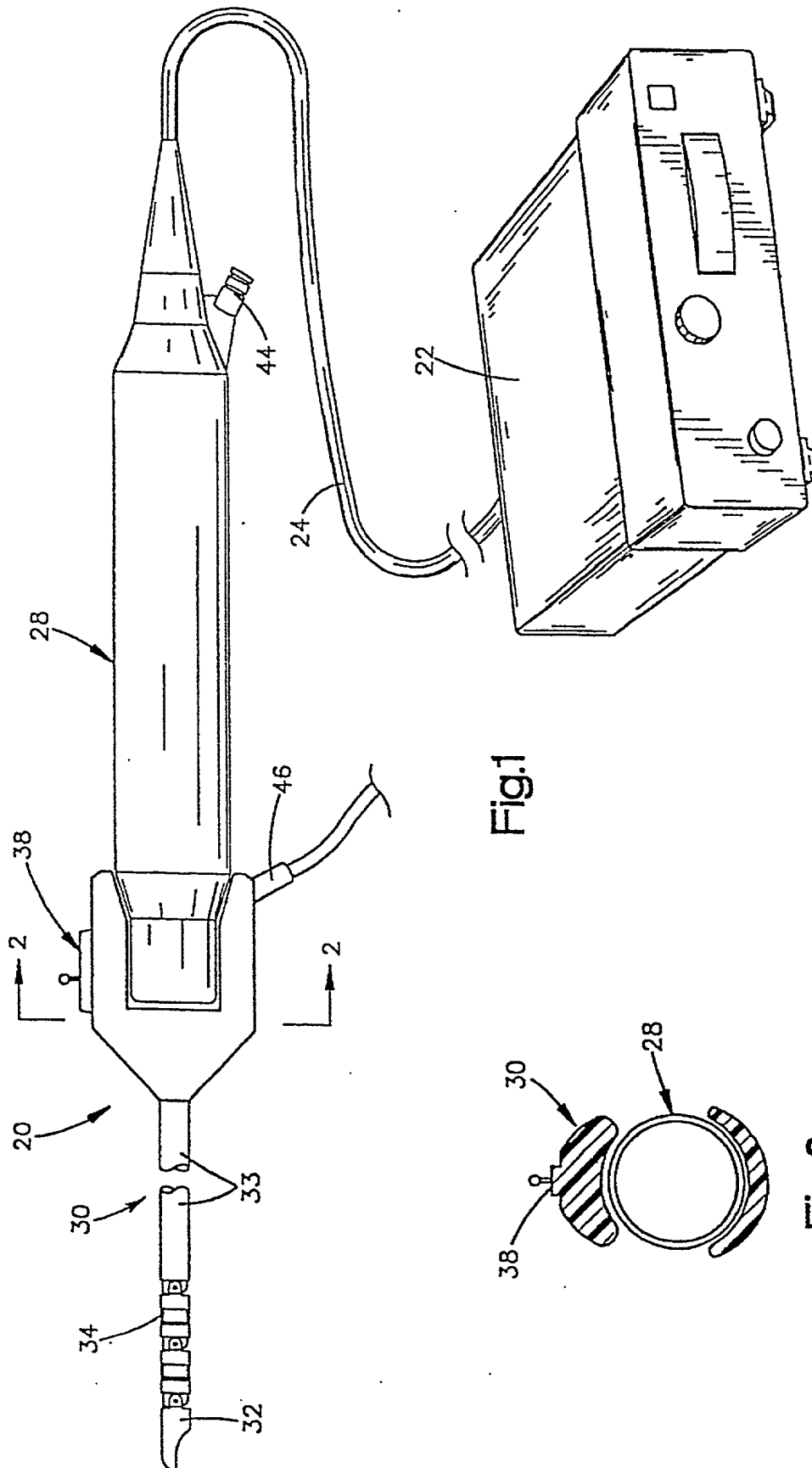


Fig.1

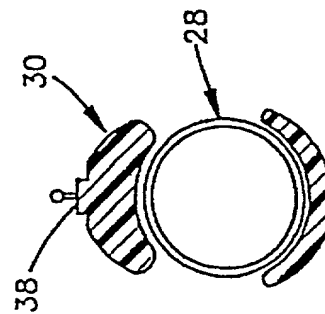


Fig.2

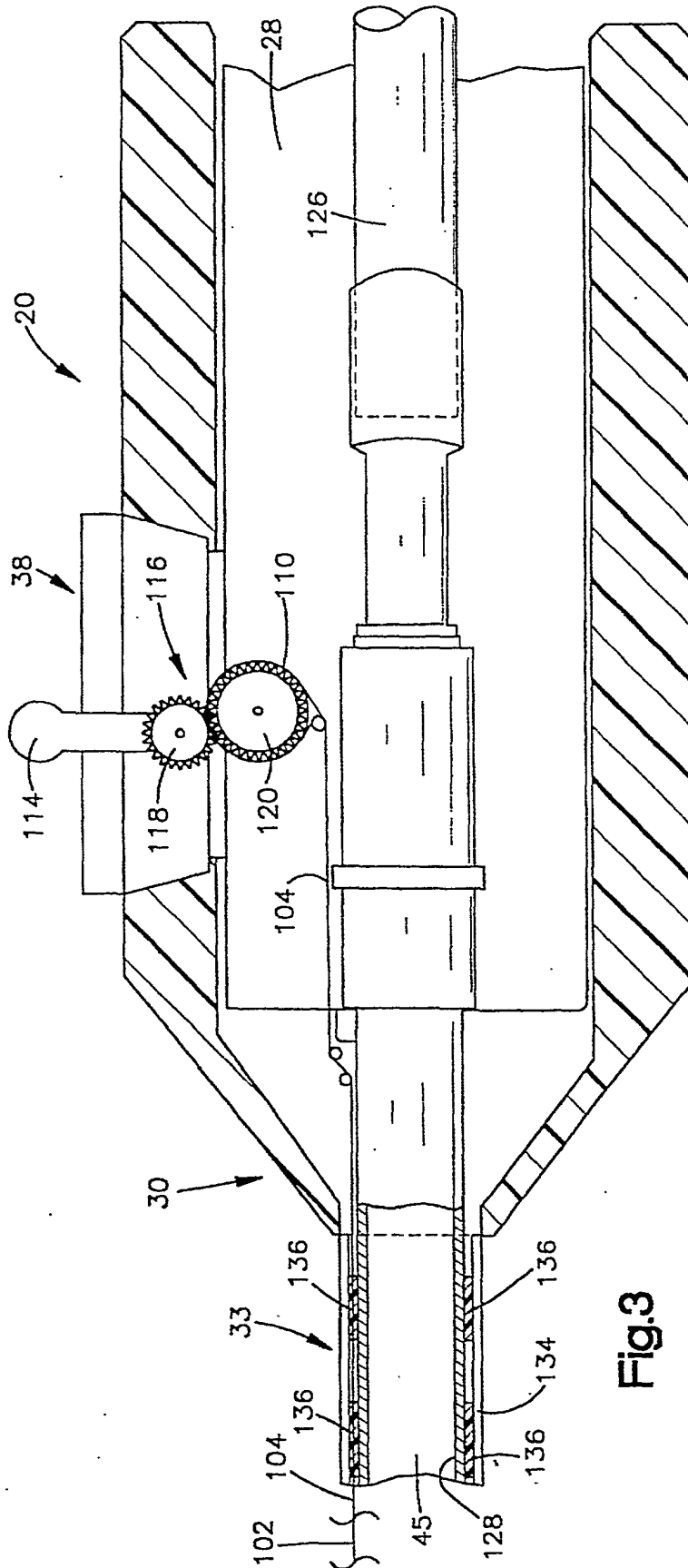
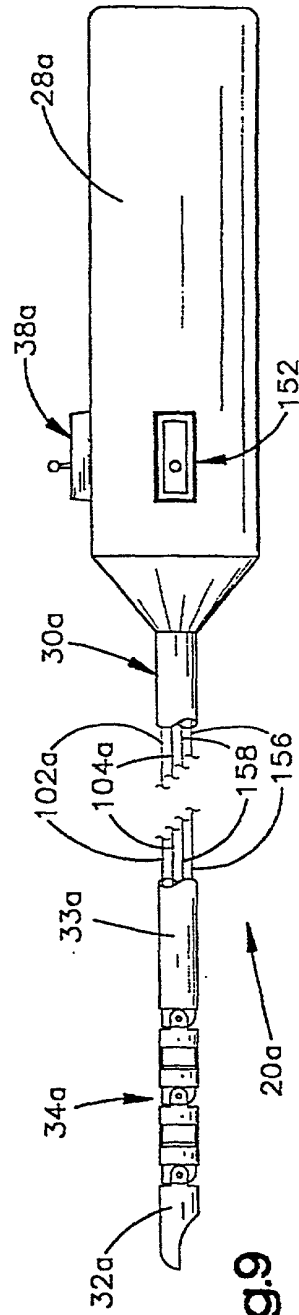
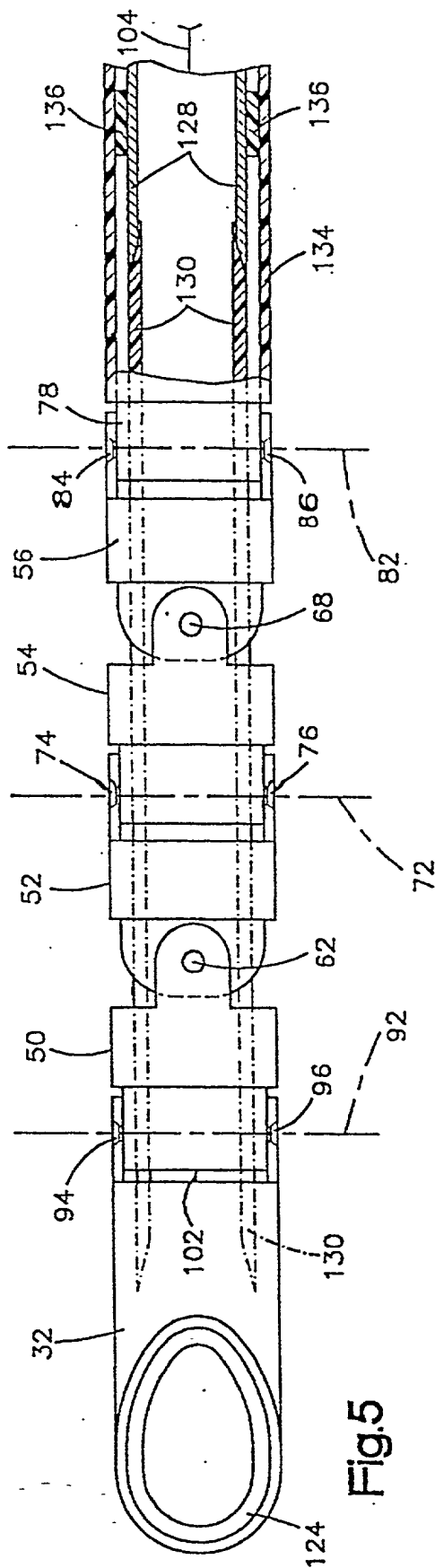


Fig. 3

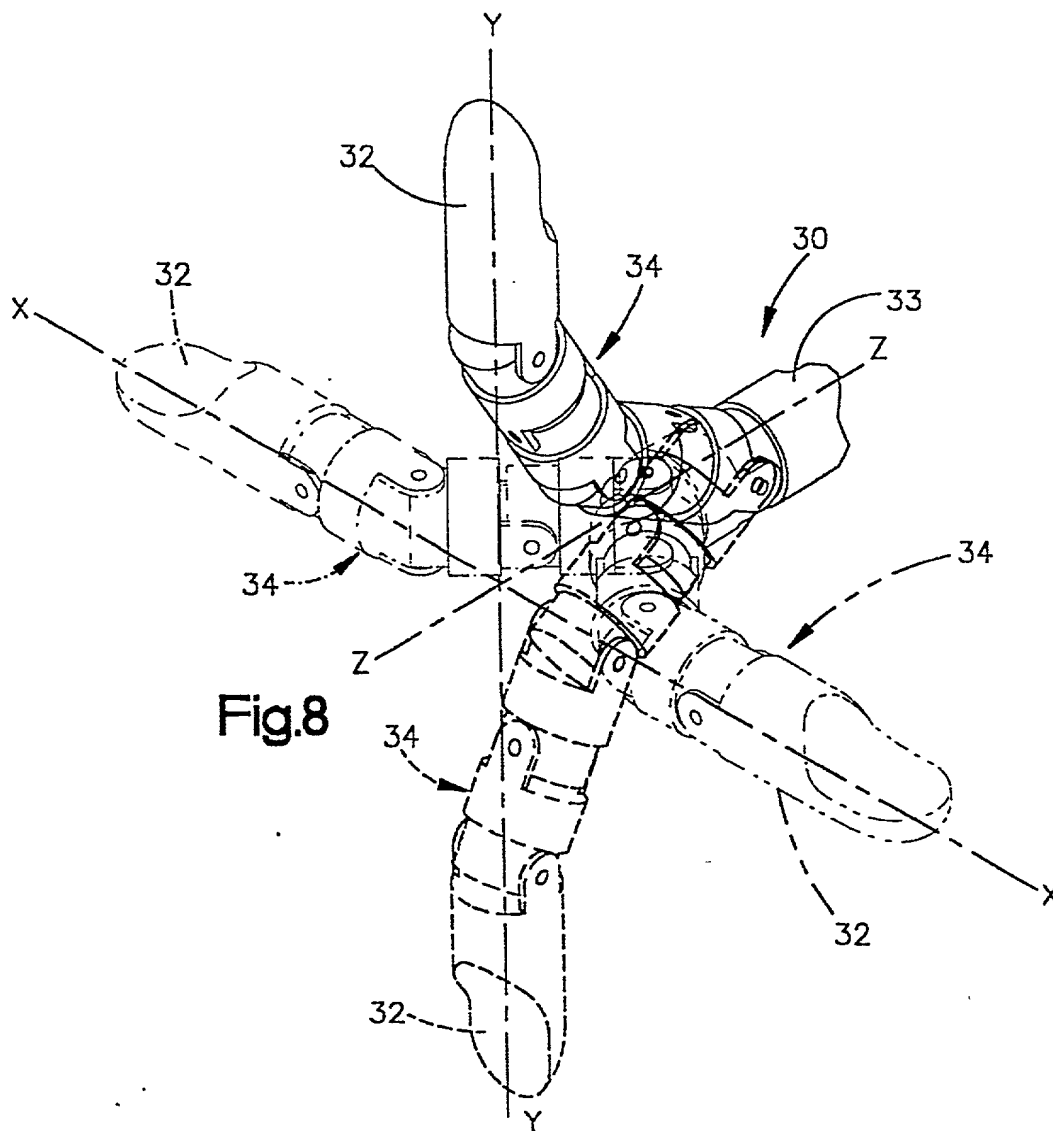
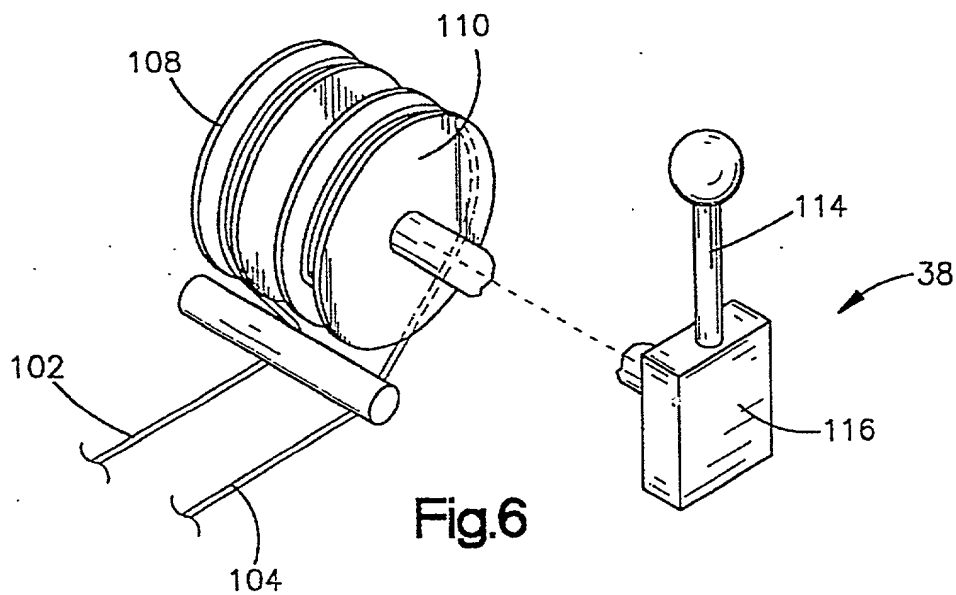


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Fig.4



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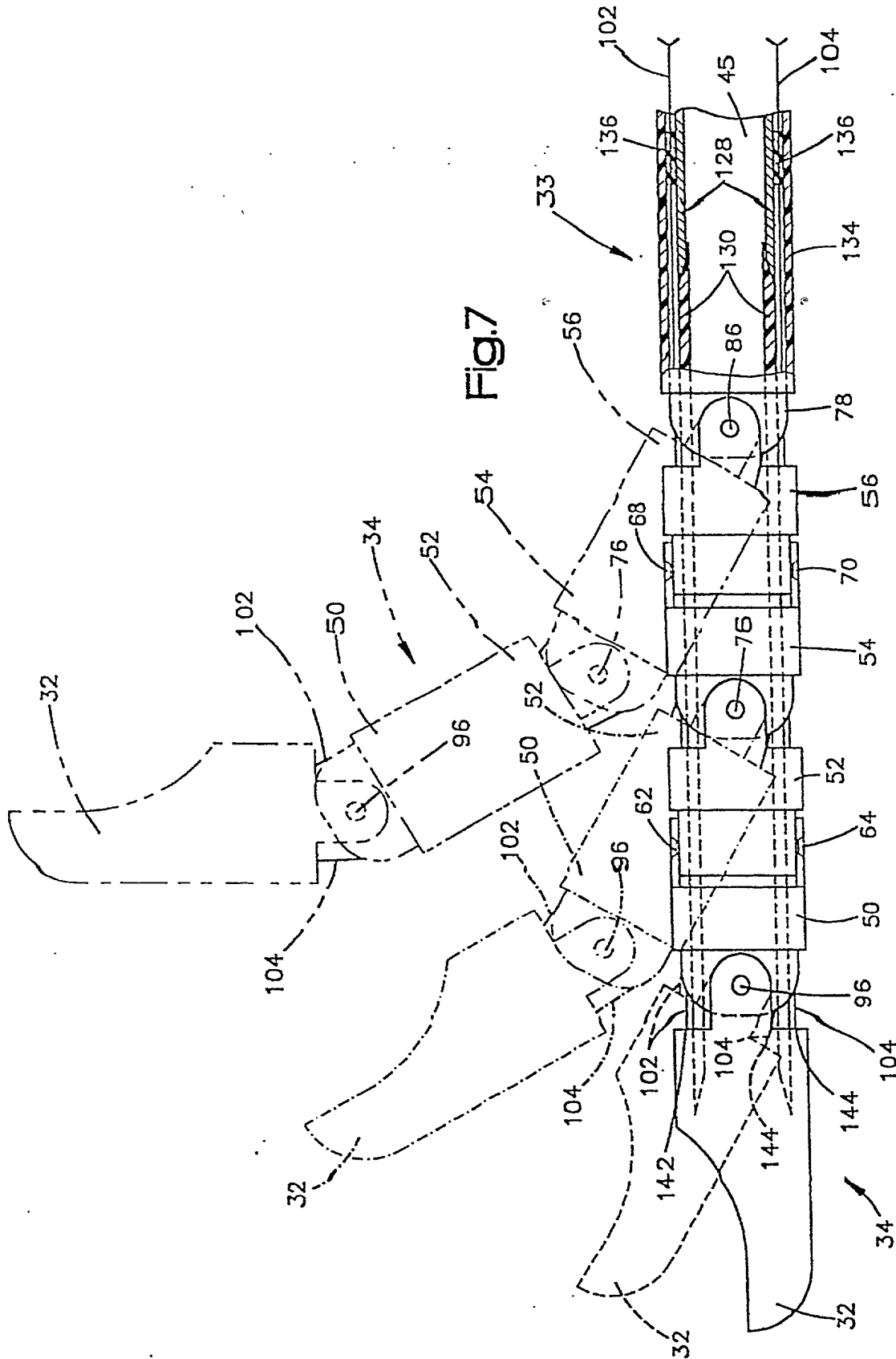


Fig. 7

PATENT

Practitioner's Docket No. A31-2047REREISSUE APPLICATION AND POWER OF ATTORNEY
(BY INVENTOR(S) OR ASSIGNEE)

(complete A or B) _____

A. ☐ DECLARATION BY THE INVENTOR(S)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (*if only one name is listed below*) or an original, first and joint inventor (*if plural names are listed below*) of the subject matter that is described and claimed in letters patent number _____, granted on _____ and for which invention I solicit a reissue patent on the invention entitled _____

the specification of which

- ☐ is attached hereto.
- ☐ was filed on _____, as reissue application number _____ and was amended on _____ (*if applicable*).
- ☐ I hereby declare that there is no assignee for this application.

NOTE: "Where no assignee exists, applicant should affirmatively state that fact. If the file record is silent as to the existence of an assignee, it will be presumed that no assignee exists." M.P.E.P., 6th ed., rev. 1, § 1410.01.

B. ☒ DECLARATION BY ASSIGNEE

NOTE: The assignee of the entire interest may make the declaration, if the reissue application does not seek to enlarge the scope of the claims of the original patent. 37 C.F.R. § 1.172

GENE P. DIPOTOVICE PRESIDENT

(type or print name of declarant)

Title

of ENDIUS INCORPORATED

Name of company or legal entity on whose behalf declarant is authorized to sign

declare that I am a citizen of U.S.A. and resident of _____, that the entire title to letters patent number 5,540,706for SURGICAL INSTRUMENTgranted on July 30, 1996 to GILBERT M. AUST AND TIMOTHY E. TAYLOR

Inventor(s)

is vested in ENDIUS INCORPORATED

Name of company or legal entity

that I believe said named inventor(s) to be an original, first and sole inventor (*if only one name is listed*) or an original, first and part inventor (*if plural names are listed*) of the subject matter that is described and claimed in the aforesaid letters patent and in the foregoing specification and for which invention I solicit a reissue patent.

EXPRESS MAIL LABEL NO. EF163919720US

(Reissue Application Declaration and Power of Attorney [17-6]—page 1 of 6)

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR (37 C.F.R. § 1.175)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information that is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

- ☒ In compliance with this duty, there is attached an information disclosure statement in accordance with 37 C.F.R. § 1.98.

PRIORITY CLAIM

NOTE: A "claim" for the benefit of an earlier filing date in a foreign country under 35 U.S.C. § 119(a)-(d) must be made in a reissue application even though such a claim was made in the application on which the original was granted. However, no additional certified copy of the foreign application is necessary. M.P.E.P., 6th ed., rev. 1, § 1417.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

(complete C or D)

- C. ☒ No such applications have been filed.
D. ☐ Such applications have been filed as follows:

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

Country	Application No.	Date of filing (day, month, year)	Date of issue (day, month, year)	Priority Claimed
				<input type="checkbox"/> YES <input type="checkbox"/> NO
				<input type="checkbox"/> YES <input type="checkbox"/> NO
				<input type="checkbox"/> YES <input type="checkbox"/> NO

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

BENEFIT OF PROVISIONAL APPLICATION

EXPRESS MAIL LABEL NO. EF163919720US

STATEMENT OF INOPERATIVENESS
OR INVALIDITY OF ORIGINAL PATENT
(37 C.F.R. § 1.175)

That I believe the original patent to be

- ☒ partly
☐ wholly

inoperative or invalid by reason of (37 C.F.R. § 1.175(a)(1)):

(check all items that may apply)

- ☐ a defective specification
☐ a defective drawing
☒ the patentee claiming more or less than the patentee had a right to claim in the patent.

NOTE: At least one error must be relied upon as the basis for the reissue. 37 C.F.R. § 1.175(a)(1).

That the error listed above, which are being corrected, up to the time of the filing of this reissue declaration arose without any deceptive intention on the part of the applicant. (37 C.F.R. § 1.175(a)(2)).

NOTE: For any error corrected not covered by this declaration applicant must submit, before allowance, a supplemental declaration stating that every such error arose without any deceptive intention on the part of the applicant. 37 C.F.R. § 1.175(b)(1).

- ☐ Corroborating affidavits or declarations of others accompany this declaration.

I believe that the original U.S. Patent No. 5,540,706 is partly invalid by reason of the patentee claiming more than the patentee had a right to claim in the patent. Specifically, claims 8 and 9 of the patent are too broad in view of World Intellectual Property Organization Publication No. WO 93/04634, dated March 18, 1993. All errors which are being corrected in the present reissue application, up to the time of the filing of this reissue declaration, arose without any deceptive intention on the part of the applicant.

EXPRESS MAIL LABEL NO. EF163919720US

(Reissue Application Declaration and Power of Attorney [17-6]—page 3 of 6)

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

Thomas L. Tarolli, Reg. No. 20,177; Robert B. Sundheim, Reg. No. 20,127; Calvin G. Covell, Reg. No. 24,042; Barry L. Tummino, Reg. No. 29,709; Paul E. Szabo, Reg. No. 30,429; James L. Tarolli, Reg. No. 36,029; Ronald M. Kachmarik, Reg. No. 34,512; Richard S. Wesorick, Reg. No. 40,871

(check the following item, if applicable)

- ☐ I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
- ☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

THOMAS L. TAROLLI

(216) 621-2234

SEND CORRESPONDENCE TO

DIRECT TELEPHONE CALLS TO:

(Name and telephone number)

☒ Address

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EXPRESS MAIL LABEL NO. EF163919720US

(Reissue Application Declaration and Power of Attorney [17-6]—page 4 of 6)

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

☐ BY THE INVENTOR(S)Full name of sole or first inventor GILBERT M. AUST

Inventor's signature _____

Date _____ Country of Citizenship U.S.A.Residence HUNTSVILLE, ALABAMAPost Office Address 715 ADAMS STREET, HUNTSVILLE, ALABAMA 35801Full name of second joint inventor, if any TIMOTHY E. TAYLOR

Inventor's signature _____

Date _____ Country of Citizenship U.S.A.Residence HOOVER, ALABAMAPost Office Address 4780 SANDPIPER LANE, HOOVER, ALABAMA 35244☒ BY ASSIGNEE OR PERSON AUTHORIZED TO SIGN ON BEHALF OF ASSIGNEE

NOTE: Even though inventor(s) do not sign, complete above information for inventor(s).

(complete the following, if applicable)

ENDIUS INCORPORATED

(type name of assignee)

23 WEST BACON STREET

Address of assignee

PLAINVILLE, MASSACHUSETTS 02762

Title of person authorized to sign on behalf of assignee

☒ Assignment recorded in PTO on December 1, 1999Reel 010437Frame 0859☐ A separate ☐ "ASSIGNMENT (DOCUMENT) COVER SHEET"

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or ☐ FORM PTO 1595 is submitted herewith along with the assignment: _____

STATEMENT BY ASSIGNEE

- ☐ Attached is a "STATEMENT UNDER 37 C.F.R. 3.73(b)," establishing the right of the assignee to take action in this reissue.

ENDIUS INCORPORATED

By



Signature of assignee or person authorized to
sign on behalf of assignee

Name GENE P. DIPOTOTitle VICE PRESIDENT

(check proper box(es) for any added page(s) forming a part of this declaration)

- ☐ Signature for third and subsequent joint inventors. Number of pages added. _____
- ☐ Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added. _____
- ☐ Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 C.F.R. § 1.47. Number of pages added. _____
- ☐ Statement of inoperativeness or invalidity of original patent. 37 C.F.R. § 1.175. Number of pages added. _____
- ☐ Authorization of attorney(s) to accept and follow instructions from representative.
- ☐ Corroborating statements of others.

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Practitioner's Docket No. A31-2047 RE

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Gilbert M. Aust et al.

Serial No.:

Group No.:

Filed:

Examiner:

For: SURGICAL INSTRUMENT

**VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) AND 1.27(c))-SMALL BUSINESS CONCERN**

I hereby declare that I am

- ☐ the owner of the small business concern identified below:
- ☒ an official of the small business concern empowered to act on behalf of the concern identified below:

Name of Small Business Concern: Endius IncorporatedAddress of Small Business Concern: 23 West Bacon Street, Plainville, Massachusetts 02762

I hereby declare that the above-identified small business concern qualifies as a small business concern, as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office under Sections 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the person employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third-party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to, and remain with, the small business concern identified above, with regard to the invention described in

- ☒ the specification filed herewith, with title as listed above.
- ☐ the application identified above.
- ☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights in the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to this invention averring to their status as small entities. (37 CFR 1.27)

FORM 7-4

CFR 1.9(c), if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each such person, concern or organization having any rights in the invention is listed below:

- ☒ No such person, concern, or organization exists.
- ☐ Each such person, concern or organization is listed below.

Name: _____

Address: _____

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

Name: _____

Address: _____

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small business entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein are of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Name of person signing: Gene P. DiPoto

Title of person signing if other than owner: Vice President

Address of person signing: 23 West Bacon Street, Plainville, Massachusetts 02762

SIGNATURE: Gene P. DiPoto DATE: 10/31/00